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APPLICANT: COLOPLUS AB

TITLE: A FEED OR FOOD PRODUCT COMPOSITION

5 The present invention relates to a feed or food product composition. More specifically, the invention relates to a feed or food product composition, which especially is adapted to deliver bioactive bovine colostrum components to the digestive tract of a mammal.

10 Colostrum is a pre-milk fluid secreted directly for up to 72 hours after birth by every mammal. Bovine colostrum consists of a mixture of lacteal secretions and constituents of blood serum, notably immunoglobulins and other serum proteins, which accumulate in the mammary gland. Its composition is quite different from that of
15 ruminant milk in established lactation. Thus, colostrum is a very complex fluid rich in nutrients, antibodies and growth factors and is characterized by its very high level of several other bioactive components.

20 There are three classes of immunoglobulins in bovine colostrum (IgG, IgA and IgM). The vast majority of total immunoglobulins (Igs) present in the mammary secretions of ruminant species (bovine) are transported from the blood. The blood Igs are overwhelmingly IgG, specifically of the IgG₁ subclass. The main natural function of the colostrum
25 immunoglobulins is to provide the calf with passive immunity.

30 The major growth factors in bovine colostrum are transforming growth factor- β s (TGF- β 1 and TGF- β 2) and insulin-like growth factors (IGF-1 and IGF-2). These factors may play an important role, especially in the growth and development of the gastrointestinal tract of newborn animals.

35 Other bioactive bovine colostrum components are some whey proteins and proteinase inhibitors as well as lactoferrin, lysozyme and lactoperoxidase, which in addition are antimicrobial components of colostrum. The growth factors

stimulate especially the growth of the gut mucosa and the bovine antibodies provide passive immunity to the newborn calf.

5 A dietary exposure to bovine immunoglobulins has several effects on the immune system of a mammal and can improve its immune defense. Immunoglobulins, cell-specific antibodies and other immune factors protect against viruses, bacteria, allergens, toxins and yeast. As any foreign protein, bovine IgG may represent a potent antigen and stimulate production of antibodies. Bovine IgG is thus
10 - apart from its antigen-specific mechanisms - able to interact with and influence the human immune system.

Research has shown that bovine colostrum is not species-specific and can work effectively in humans as well
15 as other mammals. Thus, bioactive bovine colostrum components are considered virtually identical to the corresponding colostrum components in other mammals.

In vivo, IGF-1 and IGF-2 are proposed to act both as endocrine hormones via the blood and locally as paracrine and autocrine growth factors. The major IGF form in bovine
20 colostrum, IGF-1, has been shown to stimulate cell proliferation in the GI-tract of newborn piglets and calves and may have effects on mammary tissue.

Bovine colostrum supplementation has been shown to
25 increase the serum concentration of IGF-1 in athletes during training and an anti-aging effect of bovine colostrum extract has also been reported.

It has been suggested that oral administration of colostrum immunoglobulin concentrates of bovine origin
30 could be effective in preventing diarrheal diseases such as infantile rotavirus gastroenteritis, HIV-associated diarrhoea or travelers' diarrhoea, which affects about half of all travelers to developing countries. In animals and humans, IgG₁ of bovine origin has also been shown to pass-

ively protect against infection by various enteric pathogens.

In addition, the colostral whey proteins α -lactalbumin, β -lactoglobulin, lactoferrin, lactoperoxidase, immunoglobulins, glucomacropeptide, and variety of growth factors
5 have been implicated in a number of biological effects observed in human as well as animal studies.

Colostrum, produced after immunization, contains a high concentration of specific antibodies and can be used
10 in prevention of various enteric diseases. Many clinical studies have been carried out to demonstrate the efficacy of using immune milk and colostrum preparations.

Bovine colostrum-based immune milk products have thus proven effective in prophylaxis against various infectious
15 diseases in humans. Good results have been obtained with products targeted against rotavirus, *Shigella flexneri*, *Escherichia coli*, *Clostridium difficile*, *Streptococcus mutans*, *Cryptosporidium parvum* and *Helicobacter pylori*. Some successful attempts have been made to use immune milk
20 in balancing gastrointestinal microbial flora.

In contrast to milk, colostrum is not constantly produced by the cow but only at the birth of the calf. Then it is produced in excess and only partly consumed by the calf. The remaining portion can then be collected. Thus,
25 colostrum is a natural food.

True colostrum, defined as milk from the first three milkings or milk collected during the first 24 hours after parturition, must be handled with care in order not to deactivate or reduce bioactive components. Since it is
30 impossible to completely milk out a mammary gland without injuring the cow, the first milking of colostrum contains about 80% of the biologically active components. If the collection of colostrum does not take place shortly after birth, the bioactive components will rapidly deteriorate with

time. Whole colostrum can be fractionated and utilized as separate components.

The colostrum products are manufactured from whole colostrum, defatted colostrum, whey colostrum and Ig-concentrate. Many manufacturers add excipients, emulsifiers, or other chemicals in order to obtain a better dispersability of colostrum in water.

Liquid colostrum products for dairy products are shown in US 6,202,546 and US 6,248,366, suitable dairy products being different kinds of beverages. In US 6410058 a dietary supplement composition is described, which comprises lactoferrin and colostrum and is used to synergistically promote resistance to infection, suppress existing infection, stimulate immune function or increase tissue repair and healing. Citrus pectin can be included in order to offer protection from the spread of certain cancers.

However, liquid colostrum products suffer from the same deterioration problem as the natural colostrum. The bioactivity of the colostrum components declines in dependence of the treatment, especially in the presence of water. In addition, the bioactive components also partly lose their bioactivities in all steps of a separation process and during a subsequent drying since the heat used in the drying processes and the pasteurisation reduces the colostrum bioactivities. Furthermore, the bioactive components are more thermal labile after subsequent removal of fat and other colostrum components.

When the colostrum is ingested as a liquid by a mammal with one stomach, e.g. a human being, it will empty relatively quickly from the stomach, the kinetics of liquid emptying following first order kinetics.

Under normal fed state conditions, the stomach empties only liquids and suspended finely particulate solids. In the distal part of the stomach the particle size of ingested solids is reduced to a fluid-like consistency.

After this is accomplished, the material produced is emptied as a liquid suspension.

5 The gastric emptying during the fed state involves a complex interaction between gastric peristalsis, pyloric sphincter function and feedback information from the duodenum. As the peristaltic waves approach the pylorus, they increase in speed and strength. Only a thin stream of liquid escapes into the duodenum before the pylorus contracts and occludes the lumen. The material delivered
10 to the duodenum consists of gastric secretions, digested and solubilized portions of a meal, and solid particles of food. These particles of food are driven against the closed pylorus by the rapidly advancing peristaltic wave and sheared as they are jetted back to the proximal stomach
15 when the peristaltic wave approaches the closed pylorus. This process continues until all digestible food is discharged into the duodenum.

20 The object of the invention is to provide a feed or food product composition, which comprises bioactive bovine colostrum components, whereby the above-mentioned problems are eliminated.

25 Another object of the invention is to provide a feed or food product composition, whereby the internal transit time through the digestive tract of a mammal can be prolonged and controlled.

30 Still another object is to provide a feed or food product composition, whereby the survival and resistance of the bioactive colostrum components in the gastrointestinal tract is increased and the components are protected against acid denaturation in the stomach as well as alkaline intestinal denaturation.

A further object of the invention is to provide a feed or food product composition, whereby the contact time of the colostrum components with mucosal surfaces is in-

creased, the bioactivity, e.g. local immune responses, also being increased.

Yet a further object is to provide a feed or food product composition, whereby the high buffering capacity of colostrum is maintained.

Still yet a further object is to provide a feed or food product composition, which as a dry product is suitable for storing, and which subsequently can be mixed with an aqueous liquid to a consistency suitable for intake by for example a human being. The composition should be chemically as well as biologically stable during production and storage with preserved activity, also in a final product.

Still yet another object is to provide a feed or food product composition, which fulfils all the requirements of the National Food Administration.

These objects are accomplished by the feed or food product composition according to the invention as claimed.

According to the invention, the feed or food product composition, which comprises bioactive bovine colostrum components to be delivered to the digestive tract of a mammal, should also comprise organic particulate matter as well as fat.

The composition according to the invention in its dry state is adapted to be mixed with a liquid, e.g. water or milk, preferably water, to form a product of suitable consistency for ingestion by a mammal. Although "dry", the inventive composition contains some water (less than 5 wt%). However, this water is bound water and does not negatively influence the bioactive bovine colostrum components during storage. An aqueous liquid can be added to the composition in its dry state up to 10 times its dry weight with retained effect. Of course, the amount of water depends on the amount of particulate matter in the composition.

The particulate matter in the inventive composition is used to control the time required to empty the composition from the stomach, since small particles influence the gastric emptying to a lesser degree.

5 In this connection organic particulate matter means solid or semi-solid matter that - when entering the digestive tract - influences the opening of the pylorus. The organic particulate matter should have a size of 0.3-7 mm in diameter. These particles are then reduced in size with
10 time during its mechanical treatment in the stomach.

The opening of the pylorus can also be manipulated by varying the content of the particulate matter. A low content of particulate matter results in a more fluid-like consistency of the material obtained from the distal
15 stomach. When a high content of particulate matter is processed, having a large particle size, the viscosity of the suspension obtained is increased, and the gastric emptying rate is slowed.

The particulate matter of an edible material,
20 e.g. crumbs, pellets, etc., is equally distributed in the composition. Its content in the feed or food product composition should be 40-80 wt% on dry weight basis.

Preferably, the particulate matter is insoluble dietary fibers, such as for example cellulose, rice, maize,
25 and soy fibers, which are generally only slightly digested by the intestinal flora. In this connection dietary fibers are those food fiber ingredients which are not digested by human digesting enzymes. The dietary fibers of the composition should be as tasteless and odorless as possible in
30 order not to negatively influence the final products.

Generally, the dietary fibers used are those produced in a spherical to rod-like shape. Their water retaining capacity is reduced with size. Preferably, the water retaining capacity of the fibers should not exceed 10 times

their dry weight in order not to affect the texture of the particles and thus their efficiency.

In the inventive composition the fat content can also be used for modifying the rate, by which bioactive bovine colostrum components leave the stomach. The opening of the pylorus is inhibited and delayed by fat, and an increase in fat content thus results in a retarding effect. A high fat content not only results in a longer residence time in the stomach but also in the intestine by slowing the gastro-intestinal movements.

In order to exert its effect, the fat content of the feed or food product composition should be 5-20 wt% on dry weight basis.

The fat is preferably bovine colostrum fat, which should be non-homogenised fat. However, the fat can also be vegetable fat. Suitable vegetable fat is obtained from for example rice, soy, rape, palm, and maize. Of course, the fat can be a mixture of animal and vegetable fat.

The fat also protects the immunoglobulins and growth factors from a negative exposure in the intestinal environment. It is believed that colostrum as an emulsion interacts with the particles, which in turn also protect the bioactive components.

When water has been added to the composition, an environment is provided for maintaining optimal form of delivery of bioactivity. The buffering capacity of colostrum as well as that of dietary fibers assist in withstanding the acid pH of the stomach and subsequently escaping the digestion of the bioactive components in the small intestine. The pH of the feed or food product composition should be between 5 and 7, preferably the same pH as colostrum, i.e. pH 6.3.

Colostrum of good quality should have more than 60 mg immunoglobulins/ml, the immunoglobulin content being used as a marker. IgG is the major bovine immunoglobulin, and

IgG₁ represents 90% or more of the total immunoglobulins in colostrum. In the feed or food product composition according to the invention, the bioactive bovine colostrum components should comprise 10-40 wt% bovine colostrum powder of 20-25 wt% IgG₁ on dry weight basis.

The daily intake of bioactive bovine colostrum components by a human being, preferably given twice or thrice a day, should be 10.5 g colostrum powder/day/person. This optimum colostrum content corresponds to about 2.1 to 8.0 g IgG per person and day, which should be independent of the fat content of the composition.

The immunoglobulins can be IgG, IgA, IgM, IgE, and IgY. Additional immunoglobulins can be included in the inventive composition, i.e. IgG from whey and IgY from eggs.

The inventive feed or food product composition is intended to be used as a functional food product. Preferably, such a product is a "porridge" product or a patty. The composition may further comprise nutritionally effective amounts of proteins, low molecular weight carbohydrates, vitamins and minerals.

A porridge product should per portion of about 35 g contain at least 5.25 g (15 %) colostrum powder of 20% IgG₁. It is an advantage if such a product has a high fibre bulk and is devoid of easily absorbed carbohydrates.

A patty product can comprise 30 % fat and 55 % proteins as well as flavouring agents. Milk proteins can be used as consistency agent. The nutritional benefits of whey proteins can be utilised by increasing the protein content and balance the amino acid profile of the feed or food product composition.

The feed or food product composition according to the invention is especially beneficial for patients with gastro-intestinal symptoms, where bacterial overgrowth is the cause of the symptoms.

Examples are:

- Patients with chronic HIV-associated diarrhoea.
- Patients with irritated large intestine (colon irritable), the symptoms being dominated by rumblings,
5 pains and gas tensions;
- Patients with dyspepsia, the symptoms being dominated by pains, indisposition, and bloatedness;
- Diabetics, who after long duration of the disease and insulin treatment develop altered gastric and intestinal
10 motility; and
- Patients carrying *Helicobacter pylori*.

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CLAIMS

1. A feed or food product composition, which comprises organic particulate matter, fat, and bioactive
5 bovine colostrum components to be delivered to the digestive tract of a mammal.
2. The feed or food product composition as in claim 1, wherein the content of said organic particulate matter is 40-80 wt% on dry weight basis.
- 10 3. The feed or food product composition as in claim 1, wherein said organic particulate matter has a size of 0.3-7 mm in diameter.
4. The feed or food product composition as in claim 3, wherein said organic particulate matter comprises in-
15 soluble dietary fibers.
5. The feed or food product composition as in claim 4, wherein said insoluble dietary fibers have a water retaining capacity of up to 10 times their dry weight.
6. The feed or food product composition as in claim
20 4, wherein said insoluble dietary fibers are fibers of cellulose, rice, maize, or soy.
7. The feed or food product composition as in claim 1, wherein the total water content is not more 10 times its dry weight.
- 25 8. The feed or food product composition as in claim 7, wherein the pH is between 5 and 7.
9. The feed or food product composition as in claim 1, wherein the content of said fat is 5-20 wt% on dry weight basis.
- 30 10. The feed or food product composition as in claim 1, wherein said fat is bovine colostrum fat.
11. The feed or food product composition as in claim 10, wherein said colostrum fat is non-homogenised bovine colostrum fat.
- 35 12. The feed or food product composition as in claim 1, wherein said fat is vegetable fat.

13. The feed or food product composition as in claim 12, wherein said vegetable fat is rice, soy, rape, palm, or maize fat.

5 14. The feed or food product composition as in claim 1, wherein said bioactive bovine colostrum components are growth factors and/or immunoglobulins and/or lactoperoxidase.

10 15. The feed or food product composition as in claim 14, wherein said bioactive bovine colostrum components comprise 10-40 wt% bovine colostrum powder of 20-25 wt% IgG₁ on dry weight basis.

15 16. The feed or food product composition as in claim 1, which further comprises nutritionally effective amounts of proteins, low molecular weight carbohydrates, vitamins and minerals.

ABSTRACT

The invention refers to a feed or food product composition, which comprises organic particulate matter, fat, and bioactive bovine colostrum components. The composition is intended to be delivered to the digestive tract of a mammal.

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